L11: Entry 4 of 4 File: USPT Apr 30, 2002

DOCUMENT-IDENTIFIER: US 6378246 B1
TITLE: Method and apparatus for growing vined produce

Detailed Description Text (3):
Growing container 12 comprises a cylindrical body portion 30 providing a peripheral wall 30a coaxial with axis A and having axially opposite ends 30b and 30c respectively closed as set forth more fully hereinafter by end members 32 and 34. The end members include a corresponding hub portion 32a and 34a extending across the corresponding open end of peripheral wall 30a and corresponding cylindrical handle portions 32b and 34b extending radially outwardly of peripheral wall 30a for the purpose set forth more fully hereinafter. The hub portion of each end member includes a mounting flange 36, one of which is shown in FIG. 4 in connection with end member 34, and flange 36 extends axially inwardly along the inner surface of peripheral wall 30a and is secured thereto by a plurality of threaded fasteners 38, whereby each of the end members is removably mounted on body member 30. As will be appreciated from the description of the growing container thus far, hub portions 32a and 34a of end members 32 and 34 provide end walls closing the axially opposite ends of peripheral wall 30a and providing the container with an interior for receiving a rooting media 40 which, as is well known, is a root supporting material such as, for example, a hydrophilic polymer, rock wool, perlite, a Styrofoam media, gravel, sand, vermiculite, cellulose fibers, and the like.

Current US Cross Reference Classification (3):
47/66.7

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☐ 1. Document ID: US 6748698 B1

L20: Entry 1 of 7 File: USPT Jun 15, 2004

US-PAT-NO: 6748698
DOCUMENT-IDENTIFIER: US 6748698 B1

TITLE: Water flow control system

DATE-ISSUED: June 15, 2004

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Pratt; Christopher J.	Coventry			GB

US-CL-CURRENT: 47/79; 47/32.7, 47/65.6, 47/66.7, 47/73, 47/75

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Draw D

☐ 2. Document ID: US 6679991 B1

L20: Entry 2 of 7 File: USPT Jan 20, 2004

US-PAT-NO: 6679991
DOCUMENT-IDENTIFIER: US 6679991 B1
** See image for Certificate of Correction **

TITLE: Pervaporation device and irrigation mat

DATE-ISSUED: January 20, 2004

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Van Andel; Eleonoor	Enschede			NL

US-CL-CURRENT: 210/321.6; 210/321.75, 210/640, 47/48.5, 47/51, 47/66.7, 96/6

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Draw D

☐ 3. Document ID: US 6615537 B2

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L20: Entry 3 of 7 File: USPT Sep 9, 2003

US-PAT-NO: 6615537
DOCUMENT-IDENTIFIER: US 6615537 B2

TITLE: Method of collecting materials exuded from plant roots

DATE-ISSUED: September 9, 2003

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Tonkin; Mark Christopher	The Barn			GB
Young; Mark Andrew	Hemel Hempstead			GB
Kirchner; Olaf Norbert	Wilmington	DE		

US-CL-CURRENT: 47/66.7

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Draw De

☐ 4. Document ID: US 6536160 B1

L20: Entry 4 of 7 File: USPT Mar 25, 2003

US-PAT-NO: 6536160
DOCUMENT-IDENTIFIER: US 6536160 B1

TITLE: Houseplant maintenance device and method for use

DATE-ISSUED: March 25, 2003

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Morlier; Lynn W.	New Orleans	LA		
Greve; Christopher G.	Covington	LA		
O'Connor; Ronald M.	Jefferson	LA		

US-CL-CURRENT: 47/79; 47/66.7, 47/81

Full | Title | Citation | Front | Review | Classification | Date | Reference | Claims | KWIC | Draw De

☐ 5. Document ID: US 6453610 B2

L20: Entry 5 of 7 File: USPT Sep 24, 2002

US-PAT-NO: 6453610
DOCUMENT-IDENTIFIER: US 6453610 B2

TITLE: Method for modifying root growth

DATE-ISSUED: September 24, 2002

h e b b g e e e f e ef b e

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Tonkin; Mark Christopher	Ripe Lane			GB
Young; Mark Andrew	Hemel Hempstead			GB
Kirchner; Olaf Norbert	Wilmington	DE		
Cahill; Charles William	Newark	DE		

US-CL-CURRENT: 47/66.7; 47/58.1SE

☐ 6. Document ID: US 5383943 A

L20: Entry 6 of 7 File: USPT Jan 24, 1995

US-PAT-NO: 5383943
DOCUMENT-IDENTIFIER: US 5383943 A

TITLE: Soil block for pot plant cultivation and a method of cultivating pot plants using the same

DATE-ISSUED: January 24, 1995

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Ogawa; Kinya	Kawasaki			JP
Hirasawa; Yoichi	Higashikurume			JP

US-CL-CURRENT: 47/66.7; 47/59R, 47/79

☐ 7. Document ID: US 4690697 A

L20: Entry 7 of 7 File: USPT Sep 1, 1987

US-PAT-NO: 4690697
DOCUMENT-IDENTIFIER: US 4690697 A

TITLE: Long residence pollution control system

DATE-ISSUED: September 1, 1987

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Schwartz; Arthur G.	Sunnyvale	CA	94087	
Gurries; Richard M.	Saratoga	CA	95070	
Johnson; Jay K.	La Honda	CA	97020	

US-CL-CURRENT: 47/59R; 261/119.1, 423/220, 423/234, 423/235, 423/242.2, 423/437.2,

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47/17, 47/58.1R, 47/66.7, 55/312

Full | Title | Biblio | Abstract | Claims | KWIC | Draw D

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L35: Entry 7 of 7 File: USPT Feb 21, 1989

DOCUMENT-IDENTIFIER: US 4805343 A
** See image for Certificate of Correction **
TITLE: Osmotic fiber systems

Abstract Text (1):
A hollow fiber formed of hydrophilic material and having permeable walls is treated to enhance the permeability. Reactions used to treat the fiber have a gas inside and gas outside, a gas inside and liquid outside, a liquid inside and gas outside, and a liquid inside and a liquid outside. The treatments generally involve the plasticizing of the fiber material while having the inside of the fiber at a higher pressure than the outside. These treatments produce a structural change in the fiber from a flexible tube having strong walls to expanded, rigid and somewhat fragile walls. Where more than a short length of the treated fiber is to be used, an open mesh cage is used to confine the fiber to a desired volume during treatment and to protect it subsequently. A technique for joining flexible tubing to the treated fiber is presented. The treated fiber may be used in apparatus and methods involving osmosis and reverse osmosis. Novel plant irrigation methods and apparatus are disclosed, and structures for changing the solvent quanties of solutes and measuring the osmotic pressures of solutions are also presented.

Brief Summary Text (3):
This invention relates generally to water permeable fiber systems and the preparation of the fibers, and more particularly to a system employing such fibers for plant irrigation where the fibers serve as an osmotic valve to dispense water upon demand by the plants.

Brief Summary Text (7):
The preparation of hollow cellulose acetate fibers by either hot melt extrusion or a melt spin process, results in a fiber wall having an asymmetric permeability. These hollow fibers have been used in a reverse osmosis system which applies a pressure higher than osmotic pressure to a mixture such as saline water, to cause pure water from the mixture to pass through the fiber wall into the tube. McClain et al. in U.S. Pat. No. 3,423,491 describe the preparation of such fibers.

Brief Summary Text (8):
U.S. Pat. No. 3,873,653, Meinecke et al, entitled: "Preparation of High Flux Cellulose Acetate Membranes and Hollow Fibers from Prefabricated Low Flux Specimens", discloses a process for improving the fibers disclosed by McLain so as to increase the rate at which pure water can be produced by desalinization using the fibers in reverse osmosis. It is noted that the amount of water extracted by these fibers decreases with the passage of time, requiring further treatment every 180 hours or so to maintain its improved efficiency.

Drawing Description Text (4):
FIG. 3A is a cross-section showing a first step in preparing a sealed joint on a hollow fiber;

Drawing Description Text (5):

FIG. 3B is a cross-section showing the joint of FIG. 3A after processing of the hollow fiber;

Drawing Description Text (7):
FIG. 4 is a graph showing flux density through the hollow fiber prepared in accordance with the invention as a function of time;

Detailed Description Text (2):
Hydrophilic hollow fibers such as those formed of cellulose acetate have walls which are only slightly permeable to water. Such fibers are treated to enhance this permeability. This treatment increases the diameter of the fibers, results in a reduced wall thickness and changes the fiber from a strong flexible structure to a more fragile and inflexible form. These changes make it desirable to enclose the fiber in a cage during treatment to provide the treated fiber in a form which is more readily used.

Detailed Description Text (3):
The fiber wall is a membrane having a permeability which causes it to permit the passage of water while preventing dissolved and suspended solids from passing through. This passage of water occurs due to osmosis or reverse osmosis depending upon the activity of the water on both sides of the membrane. This osmotic valve characteristic is employed as a means of providing the proper amount of irrigation to plants which may be potted. For this purpose, one or more lengths of fiber are disposed in the soil in the vicinity of the roots of the plant. Water contained in the fiber will be dispensed into the soil at a rate which will be increased when the plant exudes a bio-surfactant associated with the need for more water. On the other hand, where the soil contains an excess of water, water may pass through the fiber wall into the fiber where it may be stored. Where an open end of the fiber is also disposed in the soil, water may be drawn into the fiber by capillary action.

Detailed Description Text (7):
Disposed in the bottom of pot 10, is coiled dispensing tube 18 in cage 20. Hollow fiber or tube 18 is provided with cage 20 which prevents crushing or damage to tube 18 by the soil and plant in pot 10. Cage 20 also serves to confine tube 18 to a desired volume during the processing of dispensing tube 18 as will be described later. Tube 18 has a first end portion 24 which extends from cage 20 and leads up and into the reservoir 16. The open end of this first end portion 24 is disposed adjacent to the bottom of the reservoir 16. First end portion 24 functions as a conveying tube to convey water from reservoir 16 to dispensing tube 18. Tube 18 has a second end portion 26 which extends from cage 20 and leads up to funnel device 28 which is shown lying in packet 12. Preferably, first end portion 24 and second end portion 26 of dispensing tube 18 may be omitted from the processing referred to previously and so have wall structures which do not require protective covers. Preferably, end portions 24 and 26 are separate elements secured to dispensing tube 18, but it is necessary to avoid joints which might leak.

Detailed Description Text (10):
It has been found that periods of active plant growth are accompanied by generation of bio-surfactants which are released by the plant roots. (L.A. Errede, Annals of Botany 52. 373-380, 1983) These surfactants produce a hydrophilic soil-membrane interface which, in the case of dispensing tube 18 will cause an increase of water molecules to pass through the pores in the tube wall from the inside to the outside. Consequently, water is dispensed by the system of this. Invention mainly in response to plant needs. Excess watering which would at least be wasteful, if not harmful, is improbable using the hollow fiber of this invention. Moreover, when the plant roots become entwined with coiled dispensing tube 18, the remaining soil in the pot will become relatively dry. As a result, little moisture passes into the air in spite of the low humidity which may be maintained in the situs of the plant.

Detailed Description Text (12):
We have found that the stiff, inflexible nature of the cellulose acetate hollow fibers used as dispensing tube 18 require a flexible tubing be used at both ends for conveying tube or first end portion 24 and second end portion 26. These flexible ends allow durable connections to reservoir systems for a dispensing coil in a plant pot. It has also been found, however, that conventional connectors which are positioned in the soil will fail because root fibers penetrate the joint and force the sealed connection from the hollow fiber; causing the system to leak and fail.

Detailed Description Text (13):
Referring to FIGS. 3A-3C, a cellulose acetate hollow fiber 30 is shown in FIG. 3A having a flexible sleeve 32 positioned near the end 34 of fiber 30. Sleeve 32 need not fit snugly over hollow fiber 30. The outside diameter of fiber 30 can be from 10-50 per cent less than the inside diameter of sleeve 32. Small spacing should be allowed between the two. During the processing of hollow fiber 30 (which is described layer) hollow fiber 30 expands to a larger diameter with a thinner wall, while sleeve 32 retains its original dimensions. This is illustrated in FIG. 3B. In this expansion of hollow fiber 30, it expands within sleeve 32 to the extent sleeve 32 permits. This forms such an intimate connection along the length of sleeve 32 that roots do not penetrate in the interface between fiber 30 and sleeve 32. As shown in FIG. 3C, the excess portion of hollow fiber 30 which includes end 34 may be trimmed off to provide a clean end. A conventional connector external to the pot can then be used to join other tubing to sleeve 32.

Detailed Description Text (14):
It should be noted that the membrane surface area available in the case of the Errede experiment is limited to the cross-sectional area of the reservoir across which the membrane is stretched. In the case of dispensing tube 18, the area available is the surface of the tube wall which can be increased by making the dispensing tube longer.

Detailed Description Text (15):
Because a membrane stretched across the bottom of a vertically extending cylindrical container must be strong enough to support the weight of the water above, this membrane must be made thick enough for this requirement. Tube 18, however, may be made thin walled because of the negligible pressure of the water therein. The flow of water through the membrane is a function of thickness, so that tube 18 will, with the application of the bio-surfactant, have a higher flow rate "Q" of water than would a corresponding area of a thicker membrane.

Detailed Description Text (18):
The discussion of hollow fiber dispensing tube 18 given above was concerned with providing water from a reservoir to the roots of a plant through the fiber wall. It should not be overlooked, however, that this fiber wall is a permeable membrane which will also permit water to pass into this hollow fiber from the outside. In general, water on each side of the membrane--or in this case inside and outside the hollow fiber--will be at a hydraulic pressure which is the resultant of such factors as the hydrostatic pressure head, solids dissolved or suspended in the water, and the temperature of the water or water mixture. When the hydraulic pressure on one side of the fiber wall exceeds that on the other side by at least the osmotic pressure, water will pass through the wall to the side of the lower hydraulic pressure. Thus the fiber wall acts much as a pressure relief valve which will permit water flow when the pressure rises sufficiently.

Detailed Description Text (20):
PREPARATION OF THE HOLLOW FIBER

Detailed Description Text (33):
FIG. 4 shows graphically a characteristic of the hollow fibers prepared in

accordance with the invention. Flux density is found to increase with time over a period of about sixty days and then level off. This is to be contrasted with FIG. 3 of the Meinecke patent (U.S. Pat. No. 3,873,653) which shows a decrease in flux density which is most pronounced in about the first forty hours. It is theorized that the increase in flux density found with the hollow fibers of the present invention may result from having water pass from the inside of the fiber to the outside; whereas in the Meinecke arrangement water moves from the outside of the fiber to the inside.

Detailed Description Text (35):
Observations were made of cellulose acetate in a flat membrane form. With the membrane on a hot surface and treated with a solvent or a plasticizer, and with air above the membrane, it appears that bubbles of gas develop and burst leaving relatively large, funnel shaped cavities on the upper surface, much in the manner of a pancake batter before it is turned over. Examination of the bottom of the membrane reveals a much denser structure. With such an asymmetric permeability membrane, the preferred water flow is from the large pore side to the small pore side.

Detailed Description Text (36):
It will be recognized that while many, and perhaps most, sources of water to be used will be free of particles, there are cases where the water is highly contaminated with dissolved and undissolved solids, e.g. some well and surface water supplies. Where these highly impure waters are used directly in the reservoir which supplies the water to the dispensing tube it is necessary to periodically flush out the salts and solids from the hollow fiber to avoid blocking the water flow through the fiber or the osmotic flow through the walls of the fiber.

Detailed Description Text (37):
The necessity for this periodic flushing can be eliminated by treating the impure water by reverse osmosis to remove solid contamination and, if necessary, the use of a biocide to eliminate algae and fungi. Another approach to the treatment of impure water we have discovered is the system which will now be described with reference to FIG. 5. Pressure vessel 36 receives through inlet 38 a supply of impure water under a suitable pressure head. Control of the pressure within pressure vessel 36 may be achieved through the use of pressure regulating valve 40. Contained within pressure vessel 36 is a reverse osmosis hollow fiber coil 42. Coil 42 is made in accordance with one of the reactions taught above. Coil 42 is connected by untreated hollow fibers or tubes 44 and 46 to hollow fiber dispensing coil 48 which is located in pot 50. Coil 48 is prepared and used as previously described herein. Pressure vessel 36 may be located a suitable height above coil 48 to provide a suitable pressure head. If the pressure within pressure vessel 36 is above the osmotic pressure, water will pass through the walls of coil 42 provided the pressure within coil 42 is not too high. The pressure within coil 42 depends, in part, on the dispensing of water from coil 48. This dispensing is regulated by the plant exudate. Consequently, when the plant exudes the bio-surfactant, an increased amount of water will be dispensed from coil 48 and the pressure within coil 48, tubes 44 and 46 and coil 42 will be reduced and reverse osmosis will occur to supply water to coil 42 from pressure vessel 36. Because pressure regulating valve 40 provides a flow of water out of pressure vessel 36, water continuously flows over the exterior of coil 42, thereby flushing away particles and keeping it osmotically regenerated. Although FIG. 5 illustrates a system having a single plant with a single dispensing coil 48, it is contemplated that multiple dispensing coils may be connected to the reverse osmosis coil 42.

Detailed Description Text (40):
The osmotic valve characteristic of the hollow fibers of this invention make the fibers, without a connected reservoir, useful in controlling the water supplied to plant roots. For example, hollow fibers 60 having an internal volume of from 0.01 to 250 ml have been used in potted plants as shown in FIG. 6. These hollow fibers

will take up water from the soil both through the open ends by capillary action, and through the permeable fiber walls when excess water is in the root ball zone. This tends to restrict over-watering of the plant. This water within hollow fibers 60 will remain within the fibers, as if in a reservoir, until the hydraulic pressure outside the fiber walls is reduced sufficiently by the moisture content of the soil being reduced. Then water will be released as described with respect to the FIG. 1 embodiment.

Detailed Description Text (41):
The osmotic valve nature of the improved permeable hollow fibers of this invention make its use in measuring osmotic pressures particularly useful. Presently available osmotic pressure measurement devices do not measure the component of osmotic pressure which results from dissolved solids which are suspended in solution, but only that which results from those solids which form ions in the solution. FIG. 7 shows container 66 which receives a solution requiring an osmotic pressure measurement. Positioned in container 66 is hollow fiber 68. End 70 of hollow fiber 68 is closed, while end 72 is open. A substantial length of hollow fiber leads to end 72 and is positioned adjacent to graduated scale 74. This may be a separate fiber which is connected to the treated permeable fiber in container 66.

Detailed Description Text (42):
It will be evident that hydrophilic hollow fibers of materials other than cellulose acetate may be treated to enhance their permeability. Such materials include: polyvinyl alcohol, polyvinyl acetate, nylon, polycarbonate polyesters and epoxies. In general, fibers of a material which will hydrolyze (add water) to form a hydrophilic matrix may be used.

Detailed Description Text (43):
It will also be evident that other methods and apparatus using osmosis and reverse osmosis will benefit from the treated hollow fibers of this invention.

CLAIMS:

1. Demand watering apparatus comprising:

a dispensing tube for positioning in a pot at a location where plant roots can grow to reach said dispensing tube;

a substantially rigid foraminous enclosure containing said dispensing tube;

said dispensing tube formed of as hollow hydrophiillic material and having a tube wall constituting a semipermeable membrane which will pass water at a first rate when there is plant root demand for water, and at a second lower rate when there is no plant root demand;

said dispensing tube having at least one end available for connecting to a source of water.

5. An osmotic fiber system comprising:

a container for containing a media requiring the addition of water;

a high flux density cellulose acetate hollow fiber positioned in said container;

a foraminous enclosure rigid enough to contain said fiber having said fiber disposed therein; and

a water supply connected to said hollow fiber for providing water to said fiber at a pressure above the osmotic pressure of the water in said fiber; whereby purified

water will flow across the walls of said fiber from the high pressure side of said walls to the low pressure side of said walls.

6. An osmotic fiber system comprising:

a container for containing a media from which water must be removed;

a high flux density cellulose acetate hollow fiber for containing water positioned in said container;

a foraminous enclosure to contain said fiber having said fiber disposed therein and sufficiently rigid to prevent crushing of said fiber by said media; and

means for raising the pressure of said media above the osmotic pressure of the water in said fiber.

7. An osmotic fiber system comprising:

a pressure vessel;

a first high flux density cellulose acetate hollow fiber contained in said pressure vessel;

a foraminous enclosure rigid enough to contain said fiber having said fiber disposed therein;

a plant pot;

a second high flux density cellulose acetate hollow fiber contained in said plant pot;

a substantially rigid foraminous enclosure containing said second hollow fiber; and

a flexible tube connecting said first hollow fiber to said second hollow fiber.

8. An osmotic fiber system in accordance with claim 7 wherein:

said first and second hollow fibers are in coils each coil having first and second ends; and

a first flexible tube connects said first ends of said first and second coils and a second flexible tube connects said second ends of said first and second coils.

10. Demand watering apparatus for use with a plant in a pot containing soil comprising:

a pot having soil therein;

hollow fiber means positioned in the soil;

a substantially rigid foraminous enclosure containing said hollow fiber means; and

said hollow fiber means having walls permeable to water and impermeable to dissolved and suspended solids.

11. Demand watering apparatus in accordance with claim 10 wherein:

said hollow fiber means has a first hydraulic pressure on one side of said walls and a second hydraulic pressure on the other side of said walls; and

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water will pass through said walls in the direction from the higher hydraulic pressure to the lower hydraulic pressure.

12. Apparatus for dispensing water to the roots of a plant when there is a plant root demand comprising:

a coiled dispensing tube having two ends;

a root penetrable cage containing said dispensing tube;

said dispensing tube formed of a hydrophillic material and having a tube wall constituting a semipermeable membrane which will pass water at a first rate when there is a plant root demand for water, and at a second lower rate when there is no plant root demand; and

a delivery tube connected to at least one of said two ends of said dispensing tube.

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